Citation:

Ebbeling CB, Leidig MM, Feldman HA, Lovesky MM, Ludwig DS. Effects of a low-glycemic load vs. low-fat diet in obese young adults: A randomized trial. *JAMA.* 2007 May 16; 297(19): 2,092-2,102.

PubMed ID: 17507345

Study Design:

Randomized controlled trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine whether insulin secretion affects body fat loss among obese individuals consuming self-prepared diets by comparing the efficacy of a low-glycemic load and higher-fat diet with a low-fat and higher-glycemic load diet.

Inclusion Criteria:

- Age between 18 and 35 years
- Body mass index (BMI) of 30kg/m^2 and above
- Medical clearance from a primary care provider.

Exclusion Criteria:

- Body weight higher than 140kg
- Current smoking
- Recent adherence to a weight loss diet
- Use of medications that could affect study outcomes
- Diabetes mellitus (fasting plasma glucose 126mg per dL or higher)
- Any other major illness as assessed by a medical history and laboratory screening tests (blood urea nitrogen, creatinine, alkaline transaminase, hematocrit).

Description of Study Protocol:

Recruitment

Participants were recruited using poster fliers, newspaper and Internet advertisements and radio broadcast that described the study as an opportunity for weight loss.

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

Design

Randomized controlled trial with a six-month intensive intervention period and a 12-month follow-up period.

Dietary Intake/Dietary Assessment Methodology

- Three telephone-administered 24-hour recall interviews (two weekdays and one weekend day) were conducted at baseline and six, 12 and 18 months to assess diet
- Dietary glycemic index and load were quantified for each day according to published values based on a glucose reference.

Blinding Used

- Staff conducting recruitment and enrollment were masked to randomization sequence
- The interviewers for the telephone-administered dietary recall assessment were masked to group assignment
- Personnel collecting outcome data were masked to group assignment.

Intervention

- Low-glycemic load diet: Participants were counseled to consume low glycemic load foods and limit high-glycemic load foods. The target macronutrient composition was 40% of energy from carbohydrate, 35% from fat and 25% from protein
- Low-fat diet: Participants were counseled to consume low-fat grains, fruits and legumes and to limit intake of added fats, sweets and high-fat snacks. The target macronutrient composition was 55% of energy from carbohydrate, 20% from fat and 25% from protein
- Diets were prescribed using as ad-libitum approach. Participants were advised to heed hunger and satiety cues. Physical activity recommendations were based on public health guidelines
- There was a 6-month intensive intervention period and a 12-month follow-up period. There were 23 group workshops, one private counseling session, and five motivational phone calls.

Statistical Analysis

- The intention-to-treat principle was used in all analyses
- Baseline demographic characteristics were compared between the two groups using Fisher exact test and the T-test. The groups were also stratified by high and low insulin concentration at 30 minutes
- Dietary intakes and physical activity level over the course of the trial were analyzed by mixed model analysis of variance. Within-person correlation was accounted for by a random effect
- Age, sex, cohort (three waves of recruitment) and ethnicity/race were included as covariates in all analyses
- The primary end point of the trial, body fat percentage, was analyzed by repeated-measures analysis of variance of the baseline, six-, 12- and 18-month measurements, as described for the dietary intakes
- Effect modification was tested by adding a dichotomous variable for insulin concentration at 30 minutes after oral glucose administration
- Similar repeated measures analyses were performed for lipids, blood pressure and fasting glucose and insulin
- Repeated measures analysis of variance was used for analysis of weight change measurements obtained at baseline and weeks one, two, four, five, six, 10, 14, 17, 21, 26,

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

and then every four weeks through week 74
- Missing data were imputed conservatively.

Data Collection Summary:

Timing of Measurements

- Dietary intake: Three telephone interviews at baseline and six, 12 and 18 months
- Body weight: Baseline, and one, two, four, five, six, 10, 14, 17, 21 and 26 weeks, and then every four weeks through week 74
- Oral glucose tolerance test at baseline
- Body fat percentage, blood pressure and blood lipids, glucose and insulin: baseline and six, 12, and 18 months.

Dependent Variables

- *Weight:* Electronic scale
- *Height:* Wall-mounted stadiometer
- *Body composition:* Dual-energy x-ray absorptiometry (DEXA)
- *Body fat percentage:* Proportion of fat mass to total mass
- *Blood pressure:* Automated system with subject sitting
- *Blood lipids, glucose, and insulin:* Blood sample after a 12-hour overnight fast
- *Oral glucose tolerance:* Insulin concentration measured 30 minutes after administration of 75 g dose of dextrose.

Independent Variables

- Low-glycemic load diet or low-fat diet
- Dietary intake: Telephone interviews of 24-hour recall.

Control Variables

- Age, sex, cohort (three waves of recruitment) and ethnicity/race were included as covariates in all analyses
- Dichotomous stratification by insulin concentration at 30 minutes after a 75g dose of oral glucose.

Description of Actual Data Sample:

- *Initial N:* 73 (15 males, 58 females)
- *Attrition (final N):* 73
- *Age:* 18 to 35 years (means of 28.2 vs.26.9 years for the two groups)
- *Ethnicity:* 56% vs. 51% white for the two groups; 11% vs.16% Hispanic
- *Other relevant demographics:* Body fat percentage was 41.1 vs. 40.1% for the two groups
- *Anthropometrics:* There were no significant (NS) differences between diet groups, with the exception of LDL-cholesterol concentration
- *Location:* Boston, MA.

Summary of Results:

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

Changes in Adiposity and Cardiovascular Disease Risk Factors at 18-month Follow-up, Mean (SE)

Variables	Low-glycemic Load Diet	Low-Fat Diet	Statistical Significance of Group Difference (P-value)
Body fat percentage (insulin concentration 57.5µIU per ml or more)	-0.9 (0.5)	-1.4 (0.6)	0.56
Body fat percentage (insulin concentration more than 57.5µIU per ml)	-2.6 (0.6)	-0.9 (0.5)	0.03
LDL-cholesterol (mg per dL)	-0.3 (3.4)	-10.6 (3.3)	0.03
HDL-cholesterol (mg per dL)	-3.7 (1.5)	-8.2 (1.5)	0.03
Systolic blood pressure	-3.2 (2.3)	1.1 (2.3)	0.18
Diastolic blood pressure	0 (1.7)	2.9 (1.7)	0.22
Fasting glucose (mg per dL)	2.1 (1.3)	1.4 (1.3)	0.73
Fasting insulin (µIU per ml)	-0.8 (0.8)	0 (0.8)	0.49

Key Findings

- Weight loss did not differ between diet groups for the full cohort of 73 participants (P=0.99)
- Insulin concentration at 30 minutes after a dose of oral glucose was an effect modifier for body weight and body fat percentage. For those with insulin concentrations above the median, the low-glycemic load diet produced a greater decrease in weight (-5.8 vs. -1.2 kg, P=0.004) and body fat percentage than the low-fat diet at 18 months (see table).
- In the full cohort, plasma HDL-cholesterol and triglyceride concentrations improved more on the low-GL diet, whereas LDL-cholesterol concentration improved more on the low-fat diet
- Satisfaction with the program did not differ between the two groups.

Author Conclusion:

- The study found evidence for a diet-phenotype interaction involving insulin secretion
- For obese subjects with high insulin concentration at 30 minutes during an oral glucose tolerance test, a low-glycemic load diet may promote more weight and body fat loss than a low-fat diet
- Regardless of insulin secretion, a low-glycemic load diet has beneficial effects on concentrations of HDL-cholesterol and triglycerides, but not on LDL-cholesterol.

Reviewer Comments:

Author identified limitations include self-report for assessing dietary intake; modest sample size; and imputed data (may have led to conservative estimates).

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	Yes
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12

8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes

© 2012 USDA Evidence Analysis Library. Printed on: 08/26/12